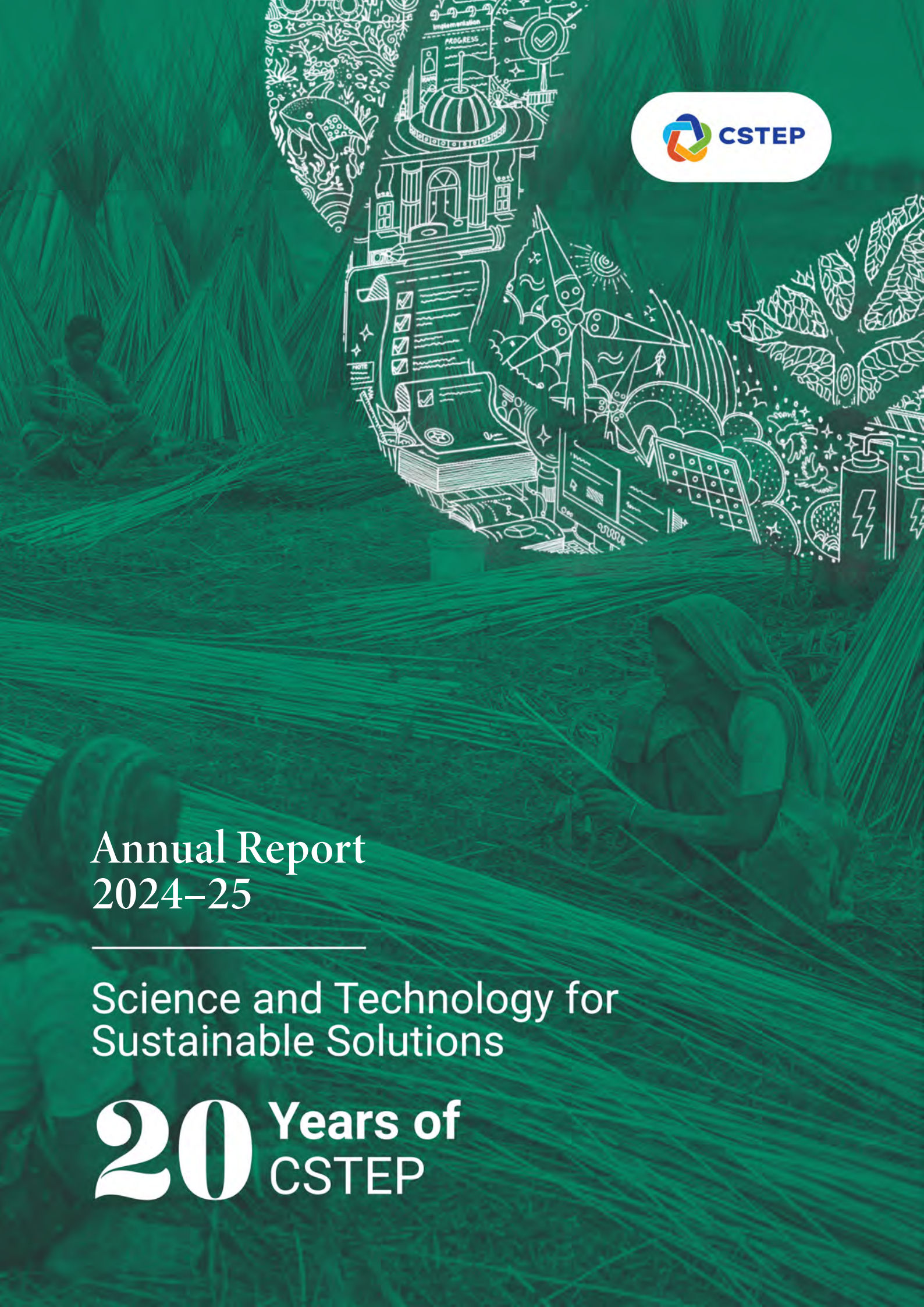


CSTEP

Annual Report 2024–25

Science and Technology for Sustainable Solutions

20 Years of CSTEP

Annual Report
2024–25

Science and Technology for Sustainable Solutions
20 Years of CSTEP

Center for Study of Science, Technology and Policy (CSTEP)
September 2025

Message from
The Chairman

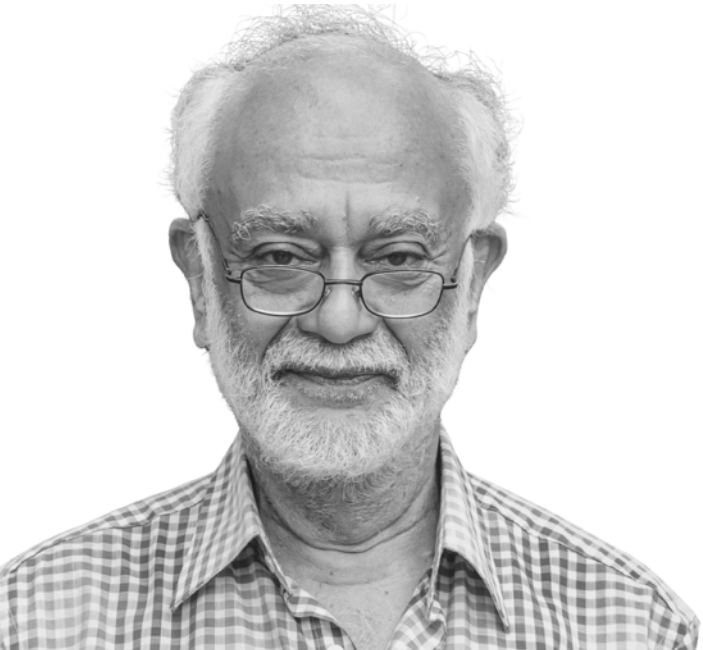
When Dr V S Arunachalam founded the Center for Study of Science, Technology and Policy (CSTEP) two decades ago, he envisioned an institution that could bridge the worlds of science, technology, and public policy. His deep conviction in the power of evidence-based thinking to shape India's development journey continues to guide us today.

Over the years, CSTEP has steadily evolved from a small research outfit into a robust institution—one that is trusted, independent, and impactful. This transformation did not happen overnight. It is the result of years of dedication, intellectual rigour, and a consistent focus on relevance and quality. Today, CSTEP is recognised as one of India's foremost think tanks in climate, energy, and air quality, influencing policy at both state and national levels.

This growth from an organisation to an institution is marked not only by formalising good governance structures but also by a deepening of values, a strengthening of processes, and the nurturing of a unique institutional culture—one that values collaboration, integrity, and innovation. We have built not just knowledge, but credibility. We have become not just a place of research, but a platform for ideas and action.

As we mark our 20th year, we stand poised to expand our role in shaping India's sustainable development trajectory. In doing so, we remain ever grateful to all who have contributed to this organisation over the years. This report is a reflection of our journey, and I hope you will enjoy reading it.

Dr Dipankar Banerjee



Message from
The Executive **Director**

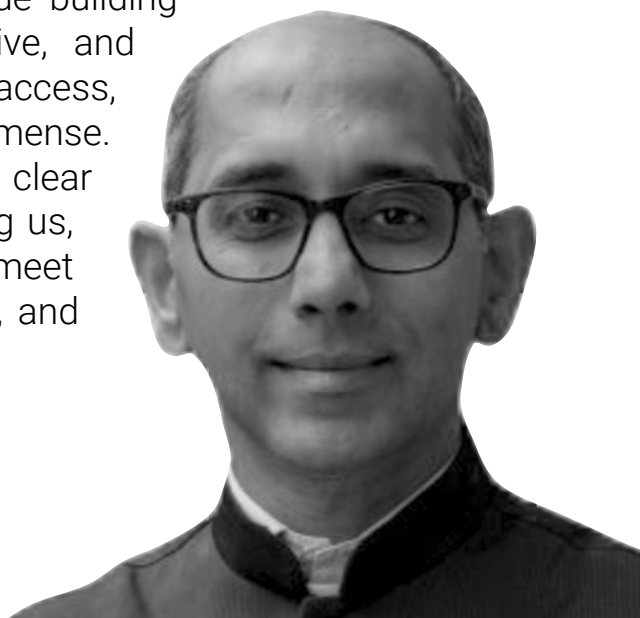
At CSTEP, we often say that our strength lies in the quality of our people and the relevance of our work. As we complete 20 years, it is heartening to reflect on how far we have come—not just in terms of the number of projects or reports, but in the kind of impact we have been able to make within our ecosystem and the culture we have built together.

We have grown over the years from a handful of researchers to a multidisciplinary team spread across thematic areas such as energy systems, clean air, climate action, and sustainability. Our body of work now includes modelling tools recognised by international bodies, state- and national-level roadmaps, and science communication efforts that go beyond policy papers to reach communities and citizens.

This growth has been intentional—built on the foundation laid by our founder, Dr V S Arunachalam, whose vision was not just to create an organisation, but to build a space where science, technology, and human values could come together to solve complex problems.

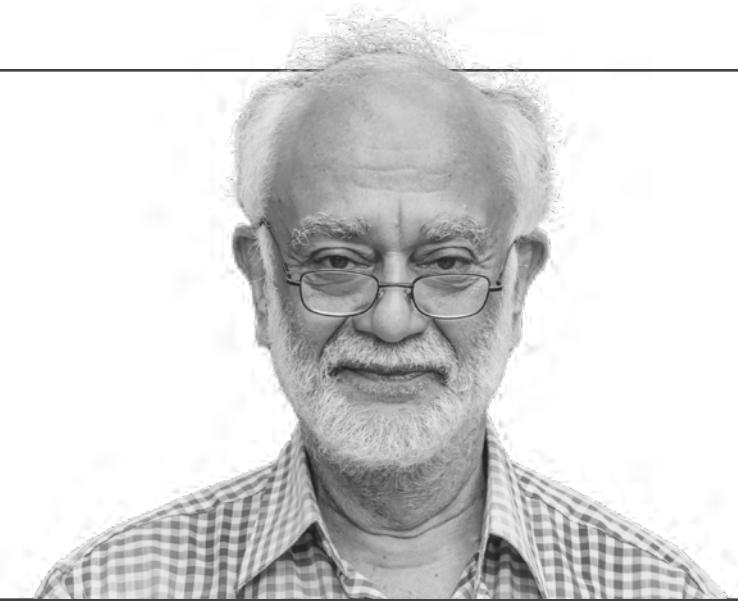
I am particularly proud of how CSTEP has evolved into a place where people grow alongside the institution, where ideas are nurtured, leadership is encouraged at every level, and professional development is embedded in our way of working. Many of our researchers have taken on leadership roles, moved across sectors (even organisations), contributed to shaping new verticals, and inspired others through their commitment.

As we look to the future, our goal is to continue building knowledge systems that are agile, collaborative, and inclusive. The challenges ahead—equitable energy access, clean air, climate change, sustainability—are immense. However, with a strong and competent team, a clear purpose, and a diverse Board of Directors guiding us, I am confident that CSTEP is well positioned to meet these grand challenges with clarity, compassion, and conviction.



Dr Jai Asundi

Board of Directors



Dr Dipankar **Banerjee**

Chairman,
CSTEP

Shri Suresh **Prabhu**

Former Member of Parliament and PM's Sherpa to G7 & G20 Summits

Former Minister of Environment & Forests, Government of India

Mr Rajat **Gupta**

Senior Partner,
McKinsey & Company

Dr Harini **Nagendra**

Director of Research Centre,
Azim Premji University

Shri Ashank **Desai**

Founder and Chairman,
Mastek

Ms Soumya **Rajan**

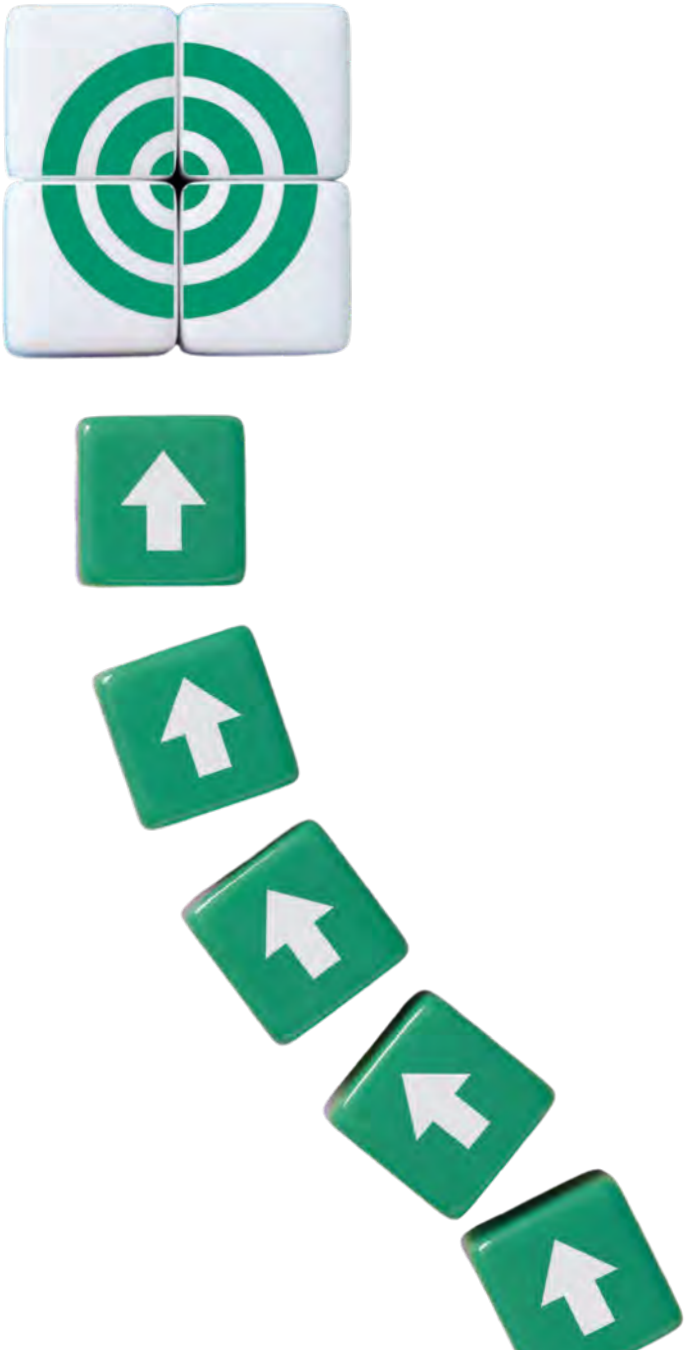
Founder, MD & CEO,
Waterfield Advisors

Dr Jai **Asundi**

Executive Director,
CSTEP


CSTEP
20-Year Journey

Milestones That Shaped **Our Journey**



20 YEARS OF CSTEP

2005

CSTEP is founded with three employees.

2008

Registers as a corporation.

Publishes first report, *Technology: Enabling the Transformation of Power Distribution.*

Receives initial funding from Shiv Nadar Foundation and Tata Trusts to work on energy and urban development.

2009

Is selected for International Development Research Centre's Think Tanks Initiative.

Receives core support from Oak Foundation.

Initiates a study on renewable energy and decarbonising hard-to-abate sectors.

2010

Contributes to the Planning Commission's report on low-carbon strategies for inclusive growth, focusing on emission reduction in power and industry sectors.

Co-chairs a steering committee with the Ministry of Mines (MoM) to prepare a roadmap addressing supply chain vulnerabilities and alternative materials science solutions.

Is appointed a member of the task force on energy storage and electric vehicles (EVs) in Karnataka.

Initiates work on Government of Karnataka projects.

2011

Assists the Planning Commission of India in developing the 12th Five Year Plan by contributing to the chapters on 'Scenarios: Shaping India's Future' and 'Climate Change and Power Sector'.

2012

Leads the policy thrust of the Solar Energy Research Institute for India and the United States (SERIIUS), a collaborative initiative focusing on advancing solar energy research and policy frameworks.

2013

Launches 'Facilitating Offshore Wind in India (FOWIND)' project, engaging closely with the Ministry of New and Renewable Energy (MNRE) and the state governments of Tamil Nadu and Gujarat.

2014

Initiates planning towards a 3 MW hybrid solar–biomass power plant in Bihar.

Engages with NITI Aayog for the India Energy Security Scenarios 2047.

2015

Organises a national energy policy workshop (renewable energy and nuclear power) in Bengaluru with NITI Aayog.

2016

Is knowledge partner to Bangalore Electricity Supply Company (BESCOM) to promote rooftop photovoltaic (RTPV) systems.

2017

Sets up an office in Noida.

Is chosen as a technical research institute by the Government of Karnataka.

2018

Prepares the Patna Clean Air Action Plan, which is approved by the Bihar State Pollution Control Board.

Conceptualises the Solution for Nutrition and Effective Health Access (SNEHA) platform to develop a malnutrition management blueprint for Karnataka using technology, championed by the Department of Women & Child Development (DWCD) and supported by the Health & Family Welfare Department (HFWD).

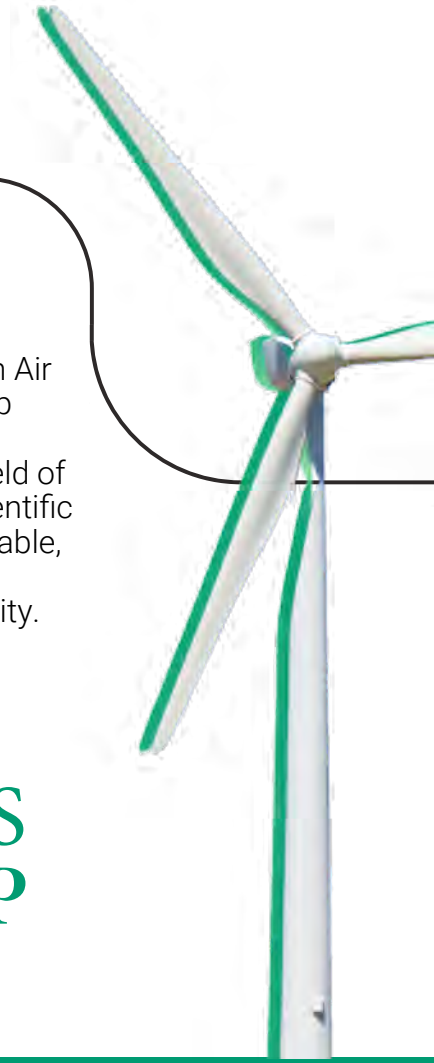
Develops a proof-of-concept urban observatory platform for Karnataka.

Undertakes Sustainable Alternative Futures for India (SAFARI) modelling studies to explore India's developmental pathways (in line with SDGs).

2019

Launches the India Clean Air Summit (ICAS), a flagship event, to bring together experts working in the field of air pollution to share scientific evidence and implementable, practical strategies for improving India's air quality.

Contd.



20 YEARS OF CSTEP

2021 Is invited by NITI Aayog to discuss ways to revive the economy in the wake of the pandemic.

Signs an MoU with the Karnataka State Pollution Control Board (KSPCB) and Bruhat Bengaluru Mahanagara Palike (BBMP) for the successful implementation of the National Clean Air Programme (NCAP) in Bengaluru.

Becomes a member of the NITI Aayog and constitutes the India Climate and Energy Modelling Forum.

The SAFARI model is used for modelling ethanol demand scenarios by NITI Aayog for the report *Roadmap for Ethanol Blending in India 2020–2025* and *Vision 2035*.

Is part of the task force set up by the Chief Minister of Karnataka for framing the Research, Development, and Innovation Policy for the state.

Conducts a pilot project in collaboration with the Bangalore Electricity Supply Company Limited (BESCOM), demonstrating the use of solar energy to charge EVs.

2020 Is acknowledged as an Institute of Repute by the Ministry of Environment, Forest and Climate Change (MoEFCC) for improving air quality in Karnataka.

The Government of Karnataka formally adopts SNEHA to monitor approximately 37 lakh children and 7 lakh women in over 65,000 Anganwadi centres.

Launches CSTEP's Rooftop Evaluation for Solar Tool (CREST) for Bengaluru, which allows consumers and distribution companies (DISCOMs) to identify suitable rooftops for rooftop photovoltaics (RTPVs).

Launches SiteRight, a decision support tool for low-impact siting of RE projects.

20 YEARS OF CSTEP

2019 *Contd.*

Wins India Smart Grid Forum Innovation Awards 2020 for the Best Smart Microgrid Project in Kudagaon, Odisha.

Assists the power transmission utility of Karnataka in strengthening the grid.

Analyses energy sector emissions as a member of the GHG Platform India to estimate India's GHG emissions.

Acts as the Secretariat for the India Energy Transformation Platform, which aims to identify technologies that can shape India's energy scenarios.

Holds an event on the role of science and technology in society, followed by the release of *From Temples to Turbines: An Adventure in Two Worlds*, written by Dr V S Arunachalam.

20 YEARS OF CSTEP

2022

Recognised as one of the 'Top 20 Best Public Policy Companies in India 2023' by Inventiva, a business magazine.

Member, India Climate and Energy Modelling Forum, NITI Aayog.

Member, Technical Advisory Committee of Experts, MoEFCC.

Member, BESCOM Rooftop Solar Committee.

Member of the core group for preparation of the Karnataka State Action Plan on Climate Change.

Develops 'Karnataka Power Sector Roadmap 2032' for the Power Company of Karnataka Limited (PCKL).

Assists the power transmission utility of Maharashtra in strengthening the grid.

2023

SAFARI included in the IPCC Sixth Assessment Report (AR6) database.

Prepares an energy transition roadmap for Kerala to go net zero by 2050.

Launches Rooftop Solar Explorer (RTSE) tool in several cities in Madhya Pradesh.

Launches the eARTh Initiative to incorporate art into climate conversations.

Sets up an air pollution lab at the CSTEP office in Bengaluru to test and calibrate low-cost sensors.

2024

Develops emission inventories for 76 Indian cities.

Launches RTSE in several cities in Chhattisgarh.

2025

Workforce grows to 124 employees.

Maps 120 cities on the MNRE portal under *PM Surya Ghar: Muft Bijli Yojana*.


India's Green
Energy Transition
Clean Air
for All
Secure and
Sustainable Future
Digital
Transformation

Key Collaborations

Key Collaborations

1

Presented state action plans on climate change

Five states: Kerala, Tamil Nadu, Karnataka, Chhattisgarh, and Manipur

2

Influenced transmission utilities

Three states: Karnataka, Andhra Pradesh, and Maharashtra

3

Developed renewable energy roadmaps

Four states: Kerala, Punjab, Assam, and West Bengal

4

Mapped rooftops for RTPVs

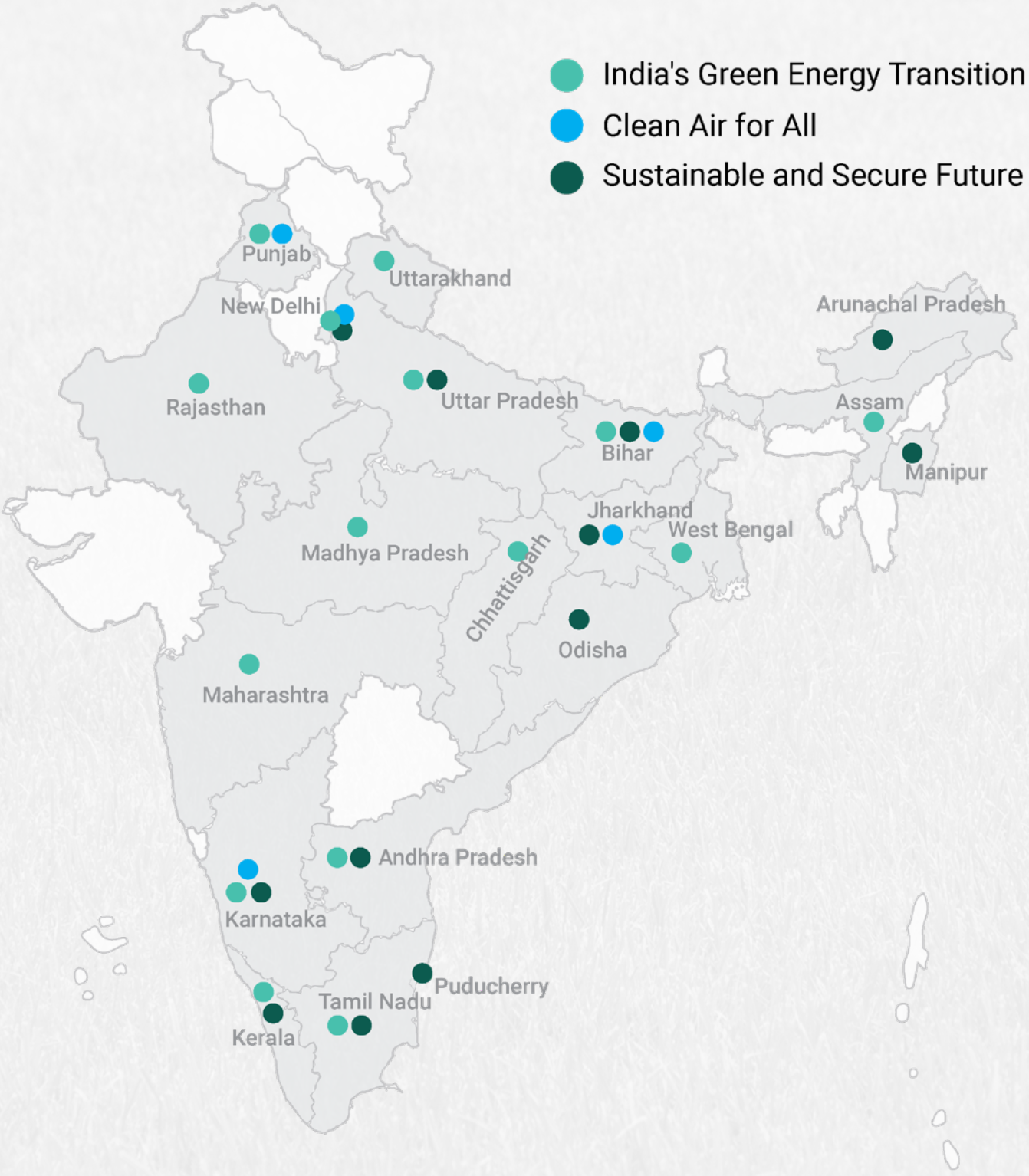
One hundred and twenty cities, including Indore, Kozikhode, Raipur, and Puducherry

5

Created emission inventories

Seventy-six cities, including Dimapur, Chandigarh, Ranchi, and Srinagar

Our Reach


India's Green Energy Transition
Clean Air for All
Sustainable and Secure Future
Punjab
Uttarakhand
New Delhi
Arunachal Pradesh
Rajasthan
Uttar Pradesh
Assam
Bihar
Manipur
Jharkhand
West Bengal
Madhya Pradesh
Chhattisgarh
Odisha
Maharashtra
Andhra Pradesh
Karnataka
Puducherry
Tamil Nadu
Kerala

Beyond the Grid

Powering Perfrom, Achieve, and Trade (PAT)

Unlocking India's Solar Potential

Fortifying Transmission Grids

The Power Map

Mapping Sustainable Futures

Tracking Air Toxins

Action on Health and Malnutrition

Charging Ahead

Making States Climate-Ready

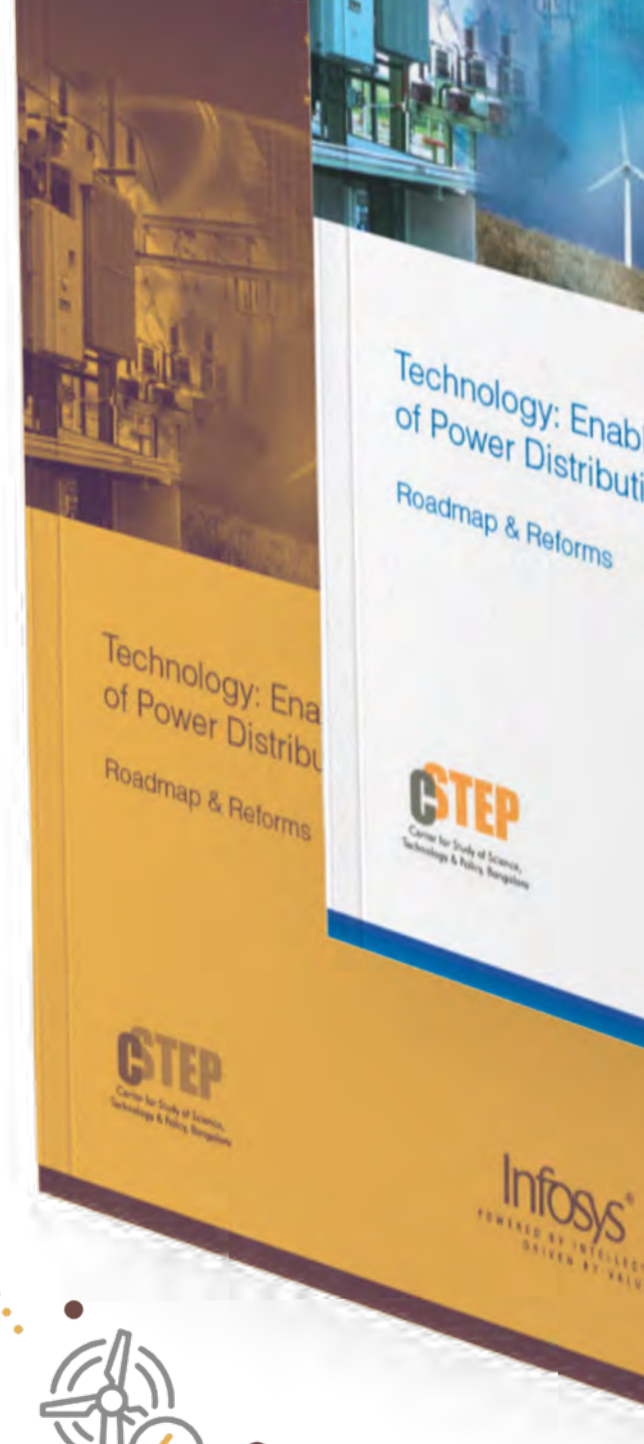
Impact Stories

Beyond the Grid

Year: **2008**

At the request of the Ministry of Power (MoP), CSTEP collaborated with Infosys to update the 2002 *IT Task Force Report for the Power Sector*. The revised report, titled *Technology: Enabling the Transformation of Power Distribution*, was published in 2008 and marked CSTEP's first publication. It highlighted the potential of digital technologies to transform India's struggling power distribution sector into an efficient, consumer-centric, and financially sustainable system.

CSTEP played a critical role in analysing the intersection of technology, business needs, and policy frameworks, emphasising that IT alone was not sufficient to drive meaningful reforms. The report advocated interoperable, future-ready smart grid systems, with recommendations tailored to each utility's unique maturity and business context.



CSTEP's contribution was crucial in highlighting the importance of strategic technology adoption, programme management,

the integration of IT with communication

and automation technologies, which are collectively referred to as digital technologies.

Importantly, the report stressed that the transformation should be holistic and systemic, involving not just technical upgrades but also governance reform, capacity building, and consumer engagement. CSTEP helped shape a long-term vision where digitally empowered utilities use advanced metering, Geographic Information System (GIS), and network management tools to reduce losses, enable real-time monitoring, and support renewable integration.

The report helped chart a roadmap that reflected India's evolving energy landscape and, in doing so, positioned CSTEP as a thought leader in powering this change.

CSTEP also highlighted the need for the creation of a national institution to lead this transformation, offering coordinated guidance on technology standards, financial viability, policy alignment, and innovation.

Powering PAT

Years: **2009–2014**

CSTEP has played a critical role in supporting the PAT scheme under India's National Mission for Enhanced Energy Efficiency (NMEEE) by working closely with the Bureau of Energy Efficiency (BEE) to develop methodologies for computing specific energy consumption (SEC) tailored to Indian industrial conditions.

This involved conducting detailed techno-economic studies; building energy consumption models for sectors such as cement, iron and steel, and textiles; and participating in consultative workshops with industry stakeholders to refine approaches.

In the cement sector, CSTEP analysed how variations in plant operations influenced baseline energy performance and helped improve methods for normalising SEC calculations.

For the iron and steel sector,

sub-process-level energy models were developed

to assess potential interventions and identify opportunities for improvement.

These contributions supported the PAT cycle design, implementation, and evaluation by enabling more accurate benchmarking and realistic target setting for industries.

Through its data-driven analysis and sector-specific insights, CSTEP continues to strengthen the effectiveness of PAT, making industrial energy efficiency a cornerstone of India's broader climate and development strategy.

Unlocking India's **Solar Potential**

Ongoing since **2013**

Energy has been a core focus for CSTEP since its inception. One of our landmark initiatives was participation in the SERIIUS, a joint research consortium launched by former US President Barack Obama and Indian Prime Minister Manmohan Singh in 2009.

One of the most impactful outcomes of this initiative is the RTSE tool, a transformative platform that helps users accurately estimate the solar potential of their rooftops and evaluate financial feasibility.

RTSE aligns with India's vision to achieve 500 GW of renewable energy by 2030 and net-zero emissions by 2070, directly contributing to the decarbonisation of the energy sector. Currently, the tool covers 120 cities across 25 states and four union territories under the Government of India's flagship programme, *PM Surya Ghar: Muft Bijli Yojana*.

The tool's journey began in 2019 with the launch of CREST in Bengaluru. Using Light Detection and Ranging (LiDAR) technology,

CREST created detailed rooftop maps,

allowing BESCOM to identify and scale up solar adoption in the city.

CSTEP's *RTSE*

By 2024, the tool had evolved into the innovative RTSE tool that could offer accurate information regarding solar generation potential, optimal system design, and economics for each consumer and provide a list of all buildings suitable for rooftop solar panels with geographical coordinates and system sizes to the DISCOMs. This was done with the help of drone and satellite images.

RTSE has been implemented in cities in Madhya Pradesh (including Bhopal, Jabalpur, Indore, and Gwalior) and Chhattisgarh (including Raipur, Durg, Bilaspur, Korba, and Raigad), enabling effective rooftop solar rollout in collaboration with state DISCOMs.

Meanwhile, MNRE's push for solar energy gave a fillip to the tool to assist the nation in the uptake of solar energy, with the Government's official portal for *PM Surya Ghar: Muft Bijli Yojana* integrating RTSE.

Between July and December 2024, over 100,000 users utilised RTSE to assess their rooftop solar potential and project financial savings over 25 years.

Fortifying Transmission Grids

Ongoing since **2016**

CSTEP was called upon to assist the power transmission utilities of Karnataka (2019), Andhra Pradesh (2021), and Maharashtra (2022) to strengthen their networks in the wake of renewable energy integration and the projected demand for the future. Our analysis submitted to the Karnataka Power Transmission Corporation Limited (KPTCL) estimates an investment of approximately INR 2,603 crore to upgrade Karnataka's transmission infrastructure by the financial year (FY) 2026–27.

CSTEP also collaborated with the Andhra Pradesh Transmission Corporation Limited (APTRANSCO) to evaluate the network's capacity to integrate high renewable energy within the state by FY 2029–30, leading to a follow-up Phase 2 grid balancing study. We carried out a transmission planning study for Maharashtra State Electricity Transmission Company Limited (MSETCL)

to assess the transmission network's capacity

to integrate higher renewable energy resources in Maharashtra by FY 2029–30.

We proposed various network recommendations, requiring an estimated investment of INR 16,097 crore. This initiative is the first of its kind in the country, aiming to supply the energy needed for agriculture through solar energy.

Alongside our work on transmission infrastructure, CSTEP has been actively engaged in helping states such as Kerala and Punjab chart actionable clean energy transition roadmaps. In Kerala, where only 30%–35% of energy needs are met by internal generation and the remainder is largely imported from coal-based sources, we developed a transition roadmap till FY 2040. This roadmap aims to help the state meet its ambitious target of sourcing 100% of its energy from renewables by 2040 and achieving net-zero emissions by 2050.

For Punjab, a state heavily dependent on thermal power (56% of its installed capacity in FY 2025), we developed a roadmap to clean energy transition till FY 2036.

Our study offers strategic guidance to diversify the state's energy mix, reduce reliance on fossil fuels, and strengthen its power sector in alignment with national climate targets, including India's 500 GW RE capacity goal by 2030.

The Power Map

Year: **2016**

CSTEP developed the Renewable Energy (RE) Atlas, one of India's earliest web-based geospatial tools to assess the potential for renewable energy across the country, specifically solar and wind energy. At a time when geospatial tools were mostly used for basic viewing, such as navigating Google Maps, but rarely integrated into analytical or planning platforms, RE Atlas was pioneering in offering a browser-based application that made this data accessible to decision-makers, researchers, and planners.

The tool allows users to visualise solar irradiance and wind power density data at a national scale, helping them identify suitable land parcels for renewable energy projects. It was designed to enable effiicient strategic energy planning, evidence-based decisions on RE site selection and infrastructure development. RE Atlas became a foundational step in CSTEP's geospatial journey, setting the stage for more advanced

applications such as RTSE, E-DEPOT, and SAFARI.

These tools went on to support clean energy transitions, sustainable urbanisation, and long-term climate planning. The Nature Conservancy (TNC) and Vasudha Foundation (VF) further helped develop RE Atlas in 2020 into SiteRight, a tool that identifies areas where solar and wind development is less likely to encounter socio-ecological conflicts, thereby helping to reduce project delays and cost overruns.

Today, while geospatial RE tools have become commonplace, RE Atlas remains a milestone in digital innovation, influencing both policy and practice across sectors.

CSTEP's early leadership in embedding GIS into energy modelling helped institutionalise spatial tools in India's energy and climate space.

Mapping Sustainable Futures

Ongoing since **2018**

CSTEP developed the SAFARI model to explore the energy, emissions, resource, and macroeconomic implications of achieving key developmental goals in India—such as food security, housing, healthcare, and transport—through a systems-thinking-based approach up to the year 2050.

Unlike conventional models that rely on gross domestic product (GDP), SAFARI uses desired quality of life (DQoL) benchmarks to simulate low-carbon development pathways and policy trade-offs. By using SAFARI,

you can create integrated scenarios across sectors

and test out the impact of policy choices on energy, emissions, and resources.

SAFARI has been showcased at global and national forums, including COP26 (IDFC Pavilion) and the International Institute for Applied Systems Analysis (IIASA) regional conference 'Systems Analysis in Eurasia'. At the national level, NITI Aayog and the Ministry of Petroleum and Natural Gas (MoPNG) used SAFARI to model ethanol demand scenarios for the *Roadmap for Ethanol Blending in India 2020-2025*, a contribution acknowledged by Dr Rakesh Sarwal (Additional Secretary, NITI Aayog) in his foreword to the report, released by the Honourable Prime Minister Narendra Modi, on World Environment Day 2021. SAFARI also informed scenarios for NITI Aayog's Vision 2035 document.

Notably, SAFARI is among the youngest models to be included in the IPCC AR6 database, affirming its credibility and relevance to the global climate discourse.

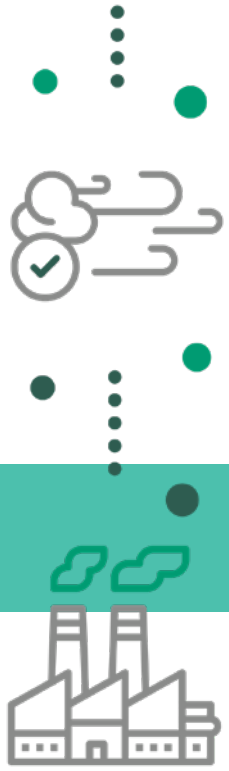
CSTEP's *SAFARI*

Through deep dives into sectors such as buildings, transport, and agriculture, SAFARI continues to promote systems thinking in India's climate and development discourse.

Tracking Air Toxins

Ongoing since **2018**

To improve scientific understanding of air pollution in India's non-attainment cities, CSTEP partnered with 12 leading Institutes of Repute under the National Knowledge Network to develop emission inventories for 76 cities across 16 states and one union territory in 2024. Known as EI 76, this open-source dataset is among the largest in India, offering 1 sq. km resolution data on PM_{10}, $PM_{2.5}$, NO_x, and SO_2 from different sources such as transport, residential use, industries, commercial cooking, and waste burning. The inventories estimate emissions for the base year 2019–20 and project future trends up to 2030, along with mitigation measures and their costs.



EI 76 is designed to complement other inventories and enables researchers to model pollution dynamics, including from peri-urban and industrial areas that are often overlooked. It provides critical input for clean air action plans by helping cities

identify key polluting sectors, understand reduction potential,

and prioritise interventions such as regular servicing of public transport, tighter vehicle controls, and public participation.

Several cities and research institutions are using the EI 76 dataset, accessible through a dedicated portal featuring city-specific visualisations and downloadable reports.

Prior to this, the Forest, Ecology, and Environment Department and the Karnataka State Pollution Control Board (KSPCB) commissioned CSTEP in 2018 to develop an emission inventory for the city's 60 km × 60 km air-shed.

CSTEP's inventory for Bengaluru was adopted by KSPCB and uploaded to PRANA, the Portal for Regulation of Air Pollution in Non-Attainment Cities.

CSTEP also developed emission inventories for six cities in Jharkhand for the base year 2019–20, independent of the EI 76 project.

CSTEP's
SNEHA

Action on Health and Malnutrition

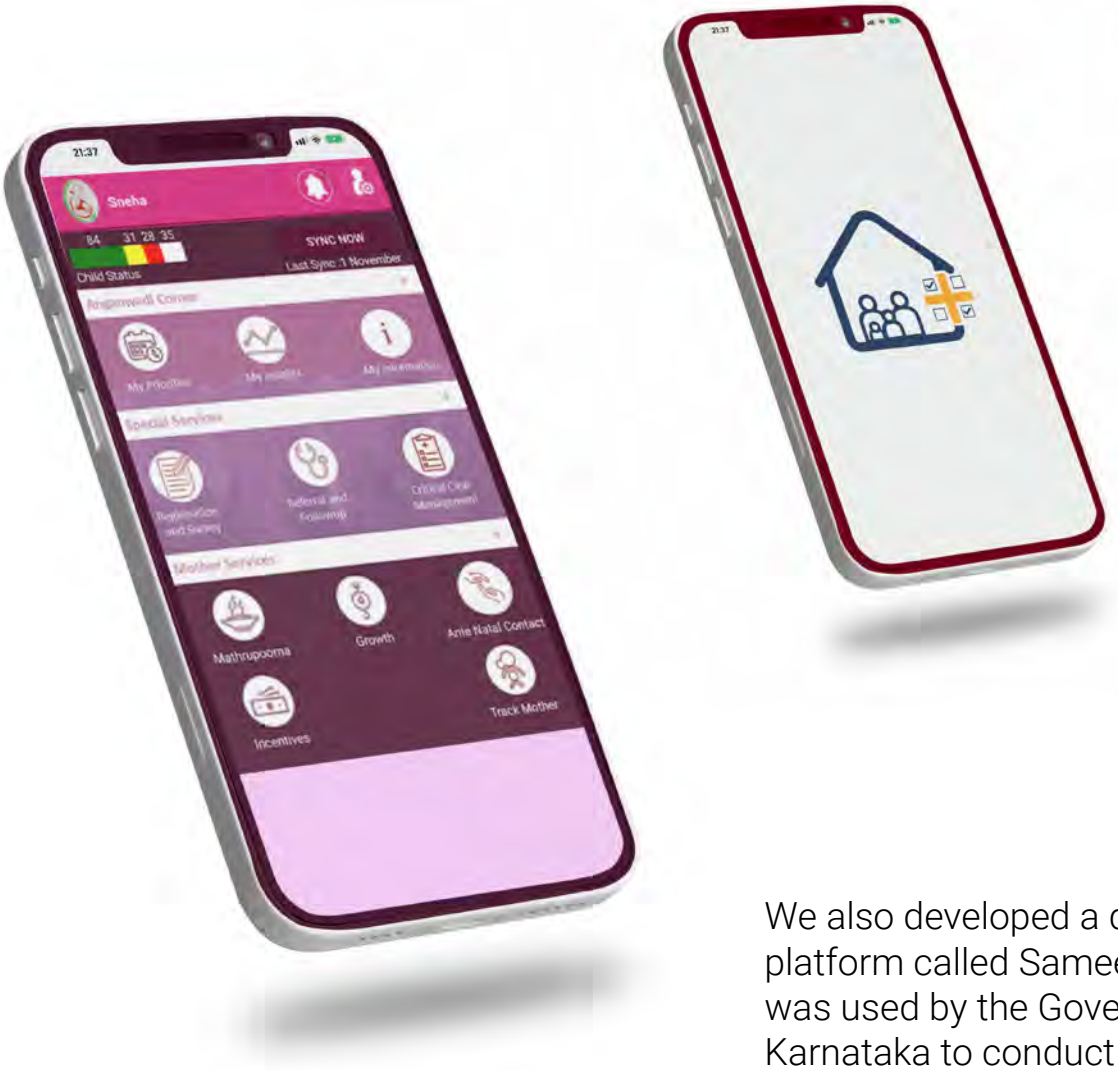
Years: **2019–2020**

CSTEP partnered with HFWD and DWCD of the Government of Karnataka in their digitisation efforts. CSTEP's Solution for Nutrition and Effective Health Access (SNEHA) project was targeted at addressing malnutrition among pregnant women and children and improving their health. Under the project, a digital platform was built for tracking the health and nutrition of women and children in Anganwadis and NRCs in the state.

The SNEHA NRC app is being used in all 32 district NRCs in Karnataka for

rehabilitating children suffering from acute malnutrition.

CSTEP extended support and training to users of the SNEHA NRC app during this period.



We also developed a digital survey platform called Sameekshe, which was used by the Government of Karnataka to conduct integrated health and family surveys.

Sameekshe has enabled the recording of data of over 1 crore individuals in Karnataka while eliminating errors, inconsistencies, and duplication by linking to the ration card ID.

Charging Ahead

Ongoing since **2021**

CSTEP developed the E-bus Depot Electrification Planning and Operational Tool (E-DEPOT) to support India's electric bus (e-bus) transition under the Faster Adoption and Manufacturing of (Hybrid &) Electric Vehicles, or FAME, scheme. E-DEPOT assists state transport undertakings (STUs) and electricity DISCOMs in planning and managing the charging infrastructure required for depot-based e-bus operations.

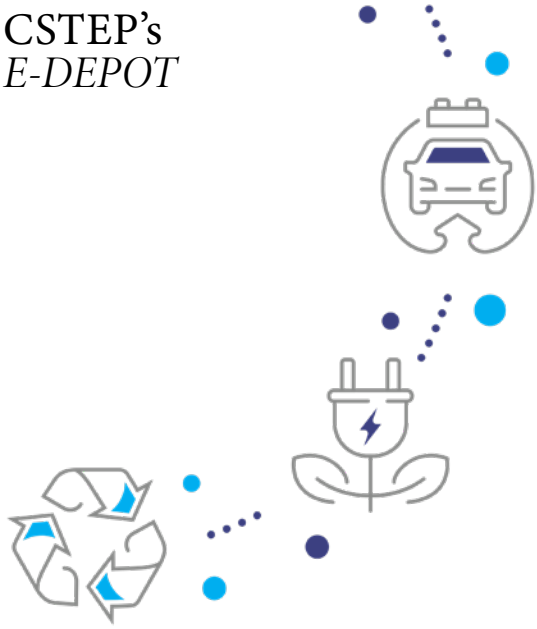
By providing evidence-based guidance on charging infrastructure, schedule viability, and cost estimation, E-DEPOT offers a robust planning framework to help cities scale up their e-bus deployment efforts efficiently and sustainably.

The tool was showcased to STUs in

Bengaluru, Kochi, Pune, and Chennai,

where it generated significant interest because of its practical utility.

CSTEP's *E-DEPOT*



CSTEP also took part in a capacity-building workshop and demonstrated the tool and its features to technical engineers from various STUs.

The workshop equipped the engineers with the skills to utilise the tool for fleet electrification planning, tender preparation, and negotiations with e-bus operators.

Making States Climate-Ready

Ongoing since **2022**

CSTEP studied changing climate patterns at a district level in states across India in 2022 and projected the likely changes in temperature and rainfall until 2050. The study got widespread policy engagement, with Kerala and Manipur incorporating the analysis into their State Action Plans on Climate Change (SAPCCs).

CSTEP also contributed to SAPCCs of Tamil Nadu, Karnataka, and Chhattisgarh to guide development through low-carbon strategies while identifying pathways for emission reduction and resilience building. The Commissioner of Karnataka, based on the climate action plan for the state, asked the line departments to come up with annual targets for mitigation.

CSTEP conducted a climate risk assessment in the Union Territory of Puducherry in 2025 and developed a Climate Risk Assessment Tool (CRAT) to visualise the climate risks to

agriculture, fisheries, health, livestock, tourism, urban, and water sectors.

This was done in collaboration with the Puducherry Climate Change Cell (PCCC).

This plug-and-play model is a web-based interactive tool that is envisaged to support climate adaptation efforts by helping to visualise climate risks to various sectors.

In 2024, CSTEP participated in a Department of Science and Technology project, *District-Level Climate Risk Assessment for India: Mapping Flood and Drought Risks Using IPCC Framework*. As part of it, CSTEP, along with IIT Mandi and IIT Guwahati, trained state climate change cells in conducting climate vulnerability and risk assessments.

Seventy-six state government officials, drawn from 20 states, were trained as part of the project. The training also covered selected civil society organisations in five states.

20 Years of CSTEP

Policy Impact & Engagements

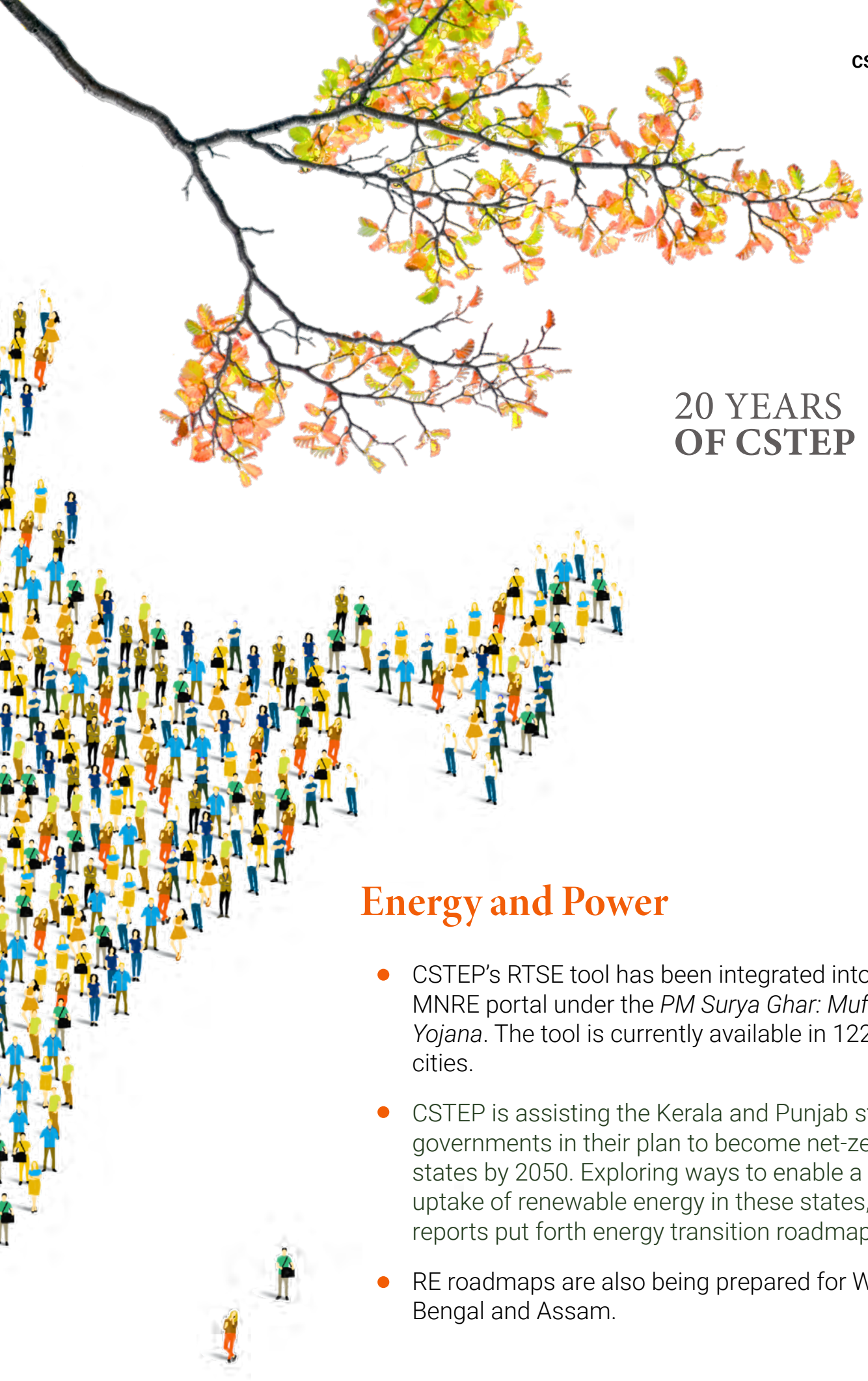
Policy Impact

Air Quality

- CSTEP conducted capacity-building workshops for pollution control boards and line departments in Karnataka, Madhya Pradesh, Odisha, Assam, Punjab, and other states on air pollution, air quality monitoring and modelling, NCAP, and mitigation measures. A knowledge dissemination session was also done for the Commission for Air Quality Management (CAQM) officials in Delhi NCR.
- CSTEP has established a multi-pollutant low-cost sensor network across the city of Bengaluru, informed by satellite estimates of surface air pollution, land-use attributes, and identification of various point-of-interest areas. The data from the sensors is shared with Google every 15 minutes, which is then used to provide almost real-time information on pollution levels in the city under its Project Air View.

Climate

- The SAFARI model was included in the suite of global models in the IPCC AR6 database.
- CSTEP's policy recommendations have made it to many SAPCCs, including Kerala, Tamil Nadu, and Karnataka.
- Conducted capacity-building projects in collaboration with IIT Guwahati and IIT Mandi to help state climate change cell members learn how to undertake vulnerability and climate risk assessment using the IPCC AR5 risk assessment methodology.



20 YEARS
OF CSTEP

Energy and Power

- CSTEP's RTSE tool has been integrated into the MNRE portal under the *PM Surya Ghar: Muft Bijli Yojana*. The tool is currently available in 122 Indian cities.
- CSTEP is assisting the Kerala and Punjab state governments in their plan to become net-zero states by 2050. Exploring ways to enable a higher uptake of renewable energy in these states, our reports put forth energy transition roadmaps.
- RE roadmaps are also being prepared for West Bengal and Assam.

Current Policy Engagements

India's Green Energy Transition

1.

Rooftop solar assessments, implementation planning, and technical assistance across multiple states and cities to support the *PM Surya Ghar: Muft Bijli Yojana* to solarise 1 crore households and government buildings across India. In parallel, our research and policy work, through national and state-level engagements, is helping promote the adoption of innovative renewable energy applications such as agrivoltaics, building-integrated photovoltaics (BIPVs), and floating solar.

3.

Least-cost resource planning for Maharashtra, Madhya Pradesh, Tamil Nadu, Andhra Pradesh, and Karnataka for reliable power with renewables-heavy grids.

2.

Transmission planning studies for the states of Maharashtra, Andhra Pradesh, Rajasthan, and Uttar Pradesh. The aim is to support state transmission utilities in planning a robust grid that can accommodate higher volumes of renewable energy while meeting the projected electricity demand by 2030.

4.

Developing model bidding guidelines for state and central aggregators to procure reliable renewable energy resources based on the least-cost model.

5.

Assessing optimal energy storage needs at the distribution level in Andhra Pradesh for 2040 through least-cost resource planning at the DISCOM level and identifying the optimal mix and capacity of renewable energy and storage, along with efficient supply-side dispatch strategies, to ensure reliable and cost-effective power delivery.

6.

Developing renewable energy transition roadmaps for Kerala, Punjab, West Bengal, and Assam. The aim is to support state utilities in forecasting long-term demand and planning the supply mix with a higher renewable energy share to cater to projected demand while meeting their renewable purchase obligation targets.

7.

Assessing the energy storage requirements for co-located projects and evaluating the technical and economic performance of coupling storage with renewables, including quantifying and comparing the costs, benefits, and value propositions for renewable energy plants.

Clean Air for All

a.

The Institute of Repute for the state of Karnataka under NCAP.

b.

Signed an MoU with the West Bengal Pollution Control Board for developing state-level strategies for clean air, AQI forecasting, capacity building, and air quality modelling.

d.

Engaged with the Commission for Air Quality Management for Delhi NCR on air quality modelling and capacity building. CSTEP is on two sub-committees for Swacha Vayu Sampark Network: (1) Air Quality Modelling and Emissions Inventory and (2) Information, Education, and Communication.

Sustainable and Secure Future

I.

Contributing to the National Adaptation Plan and developing tools for ecosystem-based adaptation in cities.

III.

Advancing the decarbonisation of India's built environment through our work on a sustainable future for the residential buildings sector.

c.

Working with the state of Punjab in the areas of stubble management and transport emissions. We have been conducting capacity-building workshops for the Punjab Pollution Control Board and line departments on air quality management across several cities.

II.

Contributing to long-term climate planning through economy-wide net-zero scenario development, financial and economic modelling of the net-zero transition, and budgetary analysis through exploring budgeting for net zero.

IV.

Promoting climate-smart agriculture to build resilience in Odisha through evidence-based planning.

V.

Strengthening institutional capacities at the grassroots to mainstream climate action and decoding pathways to a regenerative and robust rural economy.

VI.

Supporting BBMP and BESCOM in green mobility transition. The aim is to transition fleets to EVs in a phased manner while identifying suitable business models to integrate green energy (solar rooftop) for their charging.

VII.

Building capacity within school administrators and the Energy Department of Kerala to transition to clean school transportation. This is done by empowering them with various procurement pathways, financing options, and charging infrastructure planning.

VIII.

Creating an enabling ecosystem for the adoption of e-trucks at the national level, especially along the major highways, by providing a scalable and replicable implementation framework.

IX.

Supporting climate reporting by developing GHG inventories for the Land Use, Land-Use Change, and Forestry (LULUCF) sector, as part of submissions to the United Nations Framework Convention on Climate Change (UNFCCC).

20 YEARS OF CSTEP


Renewable Eneray Atlas for India.
Spoorthi
Welcome to Spoorthi
GIS Based Energy Audit Tool
CSTEP'S SOLAR TECHNO-ECONOMIC MODEL
CHOOSE OPTIONS OF INTEREST

Our Suite of Tools

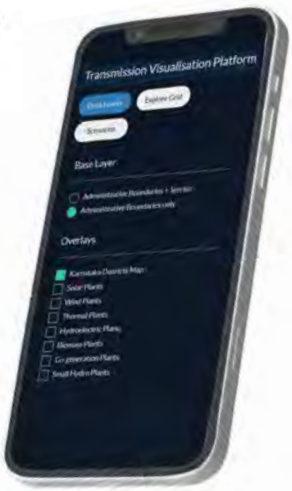
Our Suite of Tools

Our tools support evidence-based and informed policymaking.

Some of the early work around computational tools in CSTEP was focused on energy efficiency and renewable energy. Electricity distribution companies, or DISCOMs, were a key stakeholder group, and improving energy efficiency and operational effectiveness was a major priority.

Here are some prominent ones:

Feeder-wise Revenue Analysis and Monitoring of Energy Sales (FRAMES), a GIS-based tool to monitor feeder-wise revenue and energy sales, identifying loss-making areas. It enabled officials with actionable insights to reduce losses and improve financial sustainability.



Energy audit tool to accurately map feeders, distribution transformers, and consumers using GIS technology. It enabled DISCOMs to pinpoint inefficiencies, reduce energy losses, and improve operational effectiveness.

Power transmission visualisation portal was developed to allow officials to model and analyse various transmission scenarios. It empowered stakeholders at the Bihar State Power Transmission Company Limited to make informed decisions to improve transmission infrastructure and manage demand effectively.

Tool for assessment of irrigation pumps was built to improve energy efficiency of irrigation pumps through multi-criteria assessment. This tool helped the Government of Karnataka in deploying dedicated feeder routes and enabling power savings across five DISCOMs.

The renewable energy sector was nascent at the time, and there was a need to bridge the information gap for renewable systems implementation opportunities. Here are some tools that were developed:

Renewable Energy (RE) Atlas, a platform for examining land parcels suitable for RE systems. It was based on solar irradiance and wind power density data and allowed stakeholders to strategically plan for India's renewable energy expansion. With further inputs from TNC and VF, RE Atlas was developed into SiteRight.

CSTEP's Solar Techno-Economic Model for Photovoltaics (CSTEM PV), a web-based platform for techno-economic assessment of prefeasibility analysis of utility-scale PV plans. It enabled informed decision-making for solar PV deployment to support India's renewable energy targets.

As CSTEP expanded into urban management as an area of research, we explored ideas and solutions to advance inclusive urban planning.

Spoorthi, a community-owned platform to track water, sanitation, and hygiene (WASH) infrastructure and meet SDG targets. It enabled communities in Bengaluru slums to record claims via online grievance redressal, promoting equitable access and inclusive urbanisation.

Urban Observatory, a concept to aid research, analysis, and policy through geospatial and non-spatial data. It involved methods to collect, curate, and catalogue data from multiple sources to inform urban planning and policy.

When new areas were added to the scope of research, CSTEP started supporting the development of digital tools, geospatial analysis, and visualisations for research outputs in the areas of climate, environment, and sustainability and emerging technologies such as EVs and green hydrogen.

Sustainable Alternative Futures for India (SAFARI) estimates the energy, emissions, and resources implications of achieving developmental goals such as food, housing, healthcare, education, power for all, and transport up to 2050. Using SAFARI, one can create integrated scenarios across sectors and test the impact of policy choices on energy, emissions, and resources.

Solution for Nutrition and Effective Health Access (SNEHA) explored the role of digitalisation to improve efficiency, quality, and service delivery with a healthcare programme for the Government of Karnataka. This multi-year programme involved building a digital platform called SNEHA, a solution to enhance health and nutrition access to women and children in Karnataka. The platform was piloted in Bengaluru and later implemented for an entire district in Karnataka. The platform also features digital tools for conducting family surveys and supporting the care of malnourished children.

CREST

CSTEP's Rooftop Evaluation for Solar Tool (CREST) is a first of its kind tool to utilise LiDAR technology to map and evaluate rooftop solar potential while accounting for shadows and other obstacles. This pilot, which was conducted for Bengaluru, evolved to become a suite of solutions to assess rooftop solar potential across India.

E-Depot, a decision support tool built for STUs and DISCOMs to plan cost-effective and sustainable e-bus deployment

In 2022, CSTEP recognised the opportunity to apply digital transformation to grand challenges and formed a new sector called AI and Digital Platforms. Some of the new tools developed include:

Climate Risk Assessment Tool (CRAT): Puducherry, a coastal Union Territory, faces growing climate risks like sea level rise, floods, and extreme weather events. To address this, CSTEP and the Puducherry Climate Change Cell developed CRAT, which visualises sector-specific climate risks across agriculture, health, tourism, and more using IPCC's hazard-exposure-vulnerability framework. CRAT enables dynamic, interactive mapping to support informed climate action.

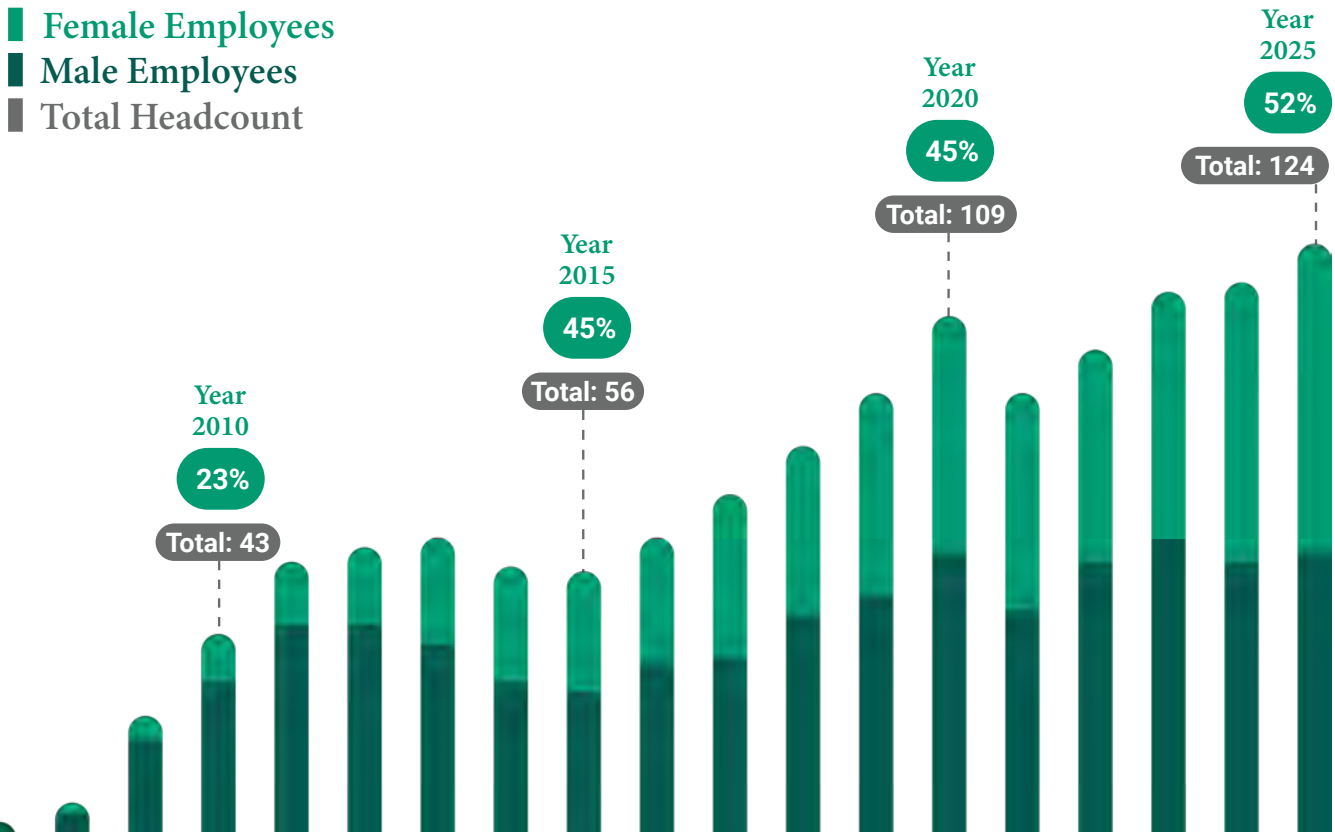
Pollution mAnagement and interVentIon Tool foR IndiA (PAVITRA): It is a cutting-edge air pollution modelling tool for India, which has been developed in collaboration with UC Berkeley, IIT Bombay, and the University of Washington. PAVITRA links emissions data to pollution outcomes, enabling better cost-benefit analysis and helping policymakers prioritise impactful, health-focused interventions across South Asia.

Solar Technology & Application Atlas of India (STAAI): India's energy demand is rising rapidly, making renewable energy—especially solar—critical to meeting future needs. To overcome land constraints and scale up to 300 GW of solar by 2030, CSTEP and partners identified seven land-neutral innovative solar applications (NISAs) such as AgriPV and floating PV, and developed STAAI, a GIS-based tool that maps their technical potential and cost-effectiveness across India. This initiative supports strategic, sustainable solar expansion by guiding policymakers and developers.

Our People

Over the past 20 years, CSTEP has grown from a small team of visionaries into a vibrant, multidisciplinary organisation powered by its people.

This journey of growth has been shaped by a culture that values learning, collaboration, and long-term commitment.



Our Supporters

Key Highlights

Initial funders were SSN Trust, Jamsetji Tata Trust, and the Defence Research and Development Organisation (DRDO).

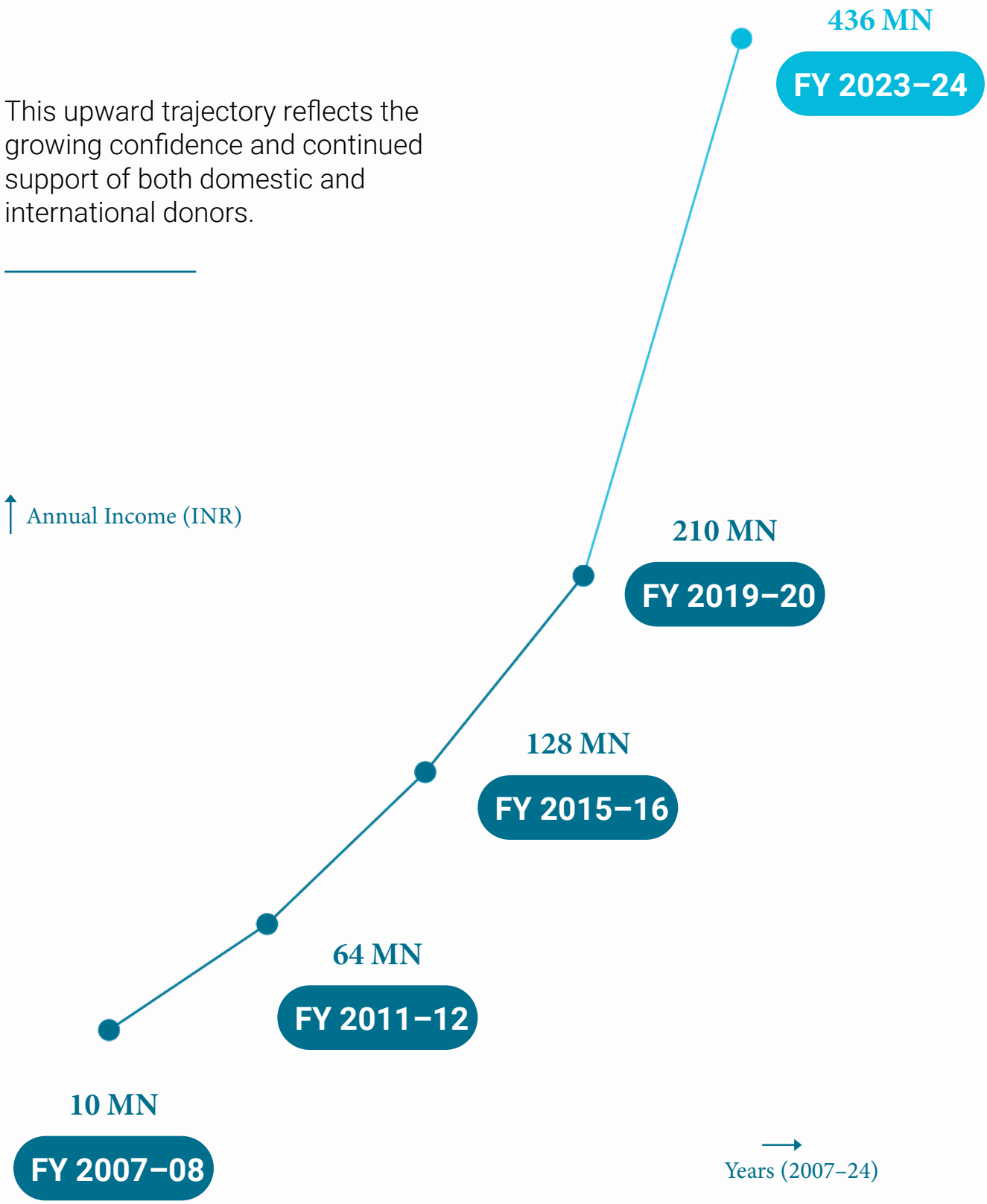
Major international funders include Bloomberg Philanthropies, the Gates Foundation, International Science and Engineering Fair (ISEF), MacArthur Foundation, Open Philanthropy, and Oak Foundation.

The organisation received its first foreign contribution in 2009–10.

Domestic contributions have come from the Rohini Nilekani Philanthropies and the Rainmatter Foundation.

Money Matters

This upward trajectory reflects the growing confidence and continued support of both domestic and international donors.



Supporters Over the Years

ROHINI NILEKANI philanthropies

Rainmatter Foundation

Bloomberg Philanthropies

BILL & MELINDA GATES foundation

Asia Community Foundation

CLEAN AIR FUND

giz Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Giving What We Can

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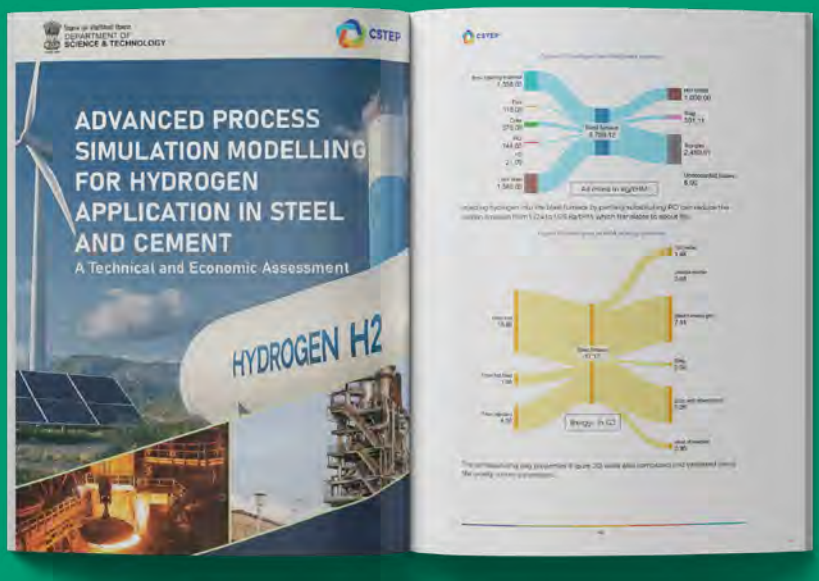
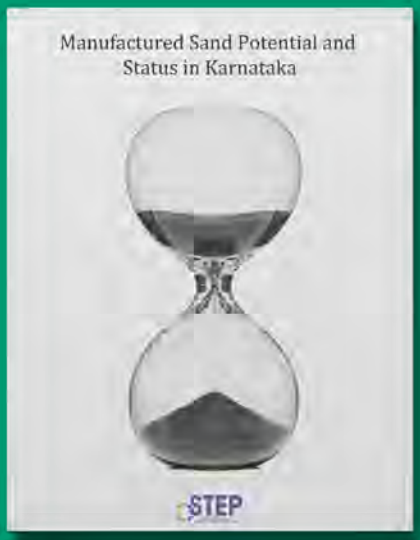
Implications for Bu
Life Cycle Assessment of ZBNF and Non-ZBNF
A Preliminary Study in Andhra Pradesh
Sea Level Rise Scenarios and Inundation Maps for Selected Indian Coastal Cities

Our Outputs


STEP
Technology Options for the Sanitation Value Chain


CSTEP
ADVANCED PROCESS SIMULATION MODELLING FOR HYDROGEN APPLICATION IN STEEL AND CEMENT
A Technical and Economic Assessment
HYDROGEN H2


Manufactured Sand Potential and Status in Karnataka
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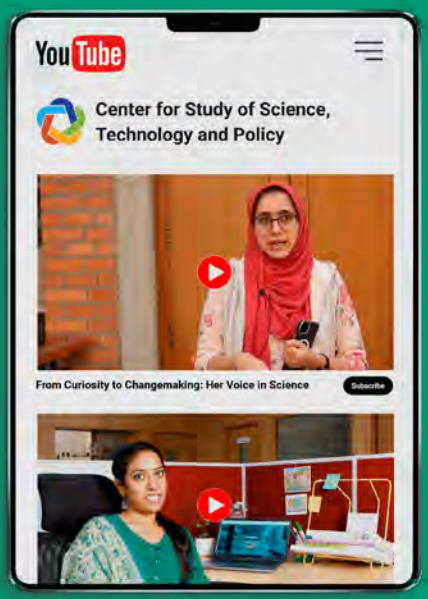
A CASE OF BENGALURU
11 a.m. to 3.30 p.m.
24 May 2025
Reading Room, Science Gallery Bengaluru
News Articles
THE HINDU
Building-Integrated Photovoltaics: converting buildings into solar assets
BIPV can turn entire buildings into power generators by integrating solar elements directly into architectural elements. While the initial costs may be high, by transforming conventional building components into energy-generating surfaces, BIPV can deliver long-term savings
The Guardian
24 Jun 2025
Traffic, crowds and construction: India's hill stations swamped by tourists escaping Delhi heat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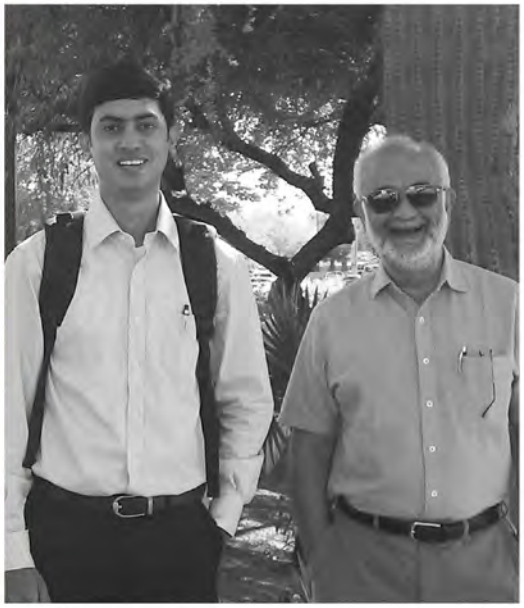
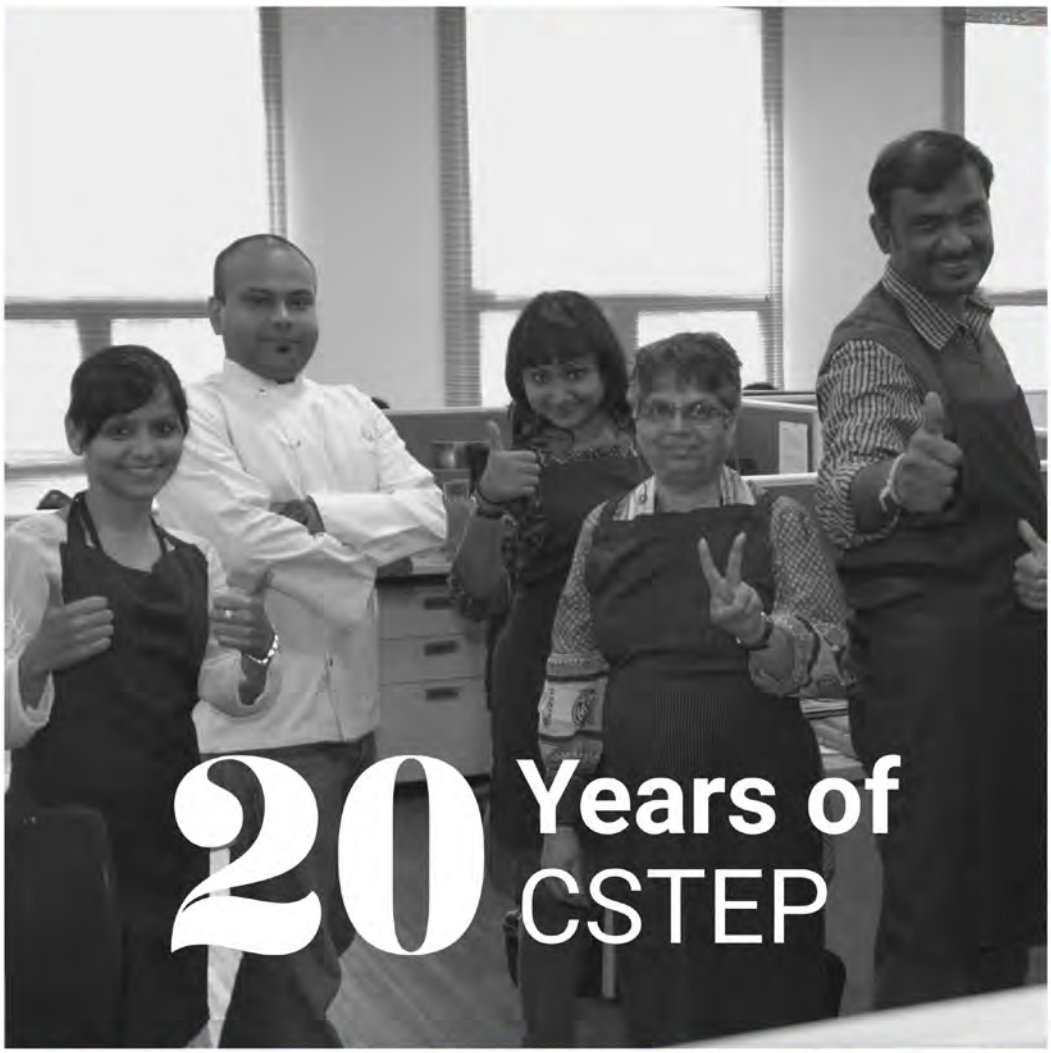


20 Years of CSTEP



20 Years of CSTEP

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